IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the proposed Variation 2 to the Proposed Canterbury Land and Water Regional Plan - Section 13 Ashburton

STATEMENT OF REBUTTAL EVIDENCE OF SHIRLEY ANN HAYWARD FOR FONTERRA CO-OPERATIVE GROUP LIMITED AND DAIRYNZ LIMITED

29 MAY 2015

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1. INTRODUCTION

1.1 My full name is Shirley Ann Hayward. I previously provided evidence in relation to this matter, on 15 May 2015.

1.2 My qualifications and experience are set out in my primary statement of evidence.

1.3 I reconfirm that I agree to comply with the Expert Witness Code of Conduct set out in the Environment Court's Consolidated Practice Note 2014, as set out in my primary evidence.

2. EXECUTIVE SUMMARY

2.1 My rebuttal evidence relates to the evidence prepared by Mr Adam Canning for The New Zealand Fish and Game Council ("**Fish and Game**"). I do not agree with the nutrient limits proposed by Mr Canning for the Hinds River/Hekeao and Spring-fed Plains waterways. The values proposed by Mr Canning appear unrealistically low compared to the range of concentrations measured at sites that meet the Variation 2 water quality outcomes for Quantitative Macroinvertebrate Community Index ("**QMCI**").

2.2 The nutrient limits proposed by Mr Canning may reflect near pristine conditions, but they are not helpful in setting realistic targets and define achievable levels of nutrient reductions for the Lower Hinds/Hekeao Plains area.

3. SCOPE OF EVIDENCE

3.1 In this rebuttal evidence, I provide additional comments on matters raised by Mr Canning for Fish and Game.

3.2 I wish to make clear that my rebuttal evidence on certain matters raised by Mr Canning does not imply that I agree with the evidence prepared by other experts or on behalf of other submitters. However, Mr Canning has raised technical matters within my area of expertise that I disagree with. As such, I consider it necessary to respond.

4. MR ADAM CANNING

Issue – nutrient limits

4.1 In paragraph 40 of his evidence in chief, Mr Canning recommends a range of nutrient concentrations that he believes are needed to support the QMCI values listed in Table 13(a) of Variation 2. His recommendations appear based largely on a regression/correlation analysis of a range of stream metrics from which he modelled concentrations of dissolved inorganic nitrogen ("**DIN**") and dissolved reactive phosphorus ("**DRP**") that correlated with Variation 2 QMCI values. There are insufficient details in his analysis to determine the range and significance of other metrics and the relative importance of nutrient concentrations in predictions of QMCI values. However, I am primarily concerned that his analysis has produced an unrealistically low nutrient concentration threshold, which, regardless of the method used, appears to represent nutrient levels of a largely pristine environment.

4.2 I agree with Mr Canning that nutrients are an influencing factor on in-stream biotic communities, particularly through the effects of excessive growth of periphyton (and macrophytes). At high concentrations, some nutrient forms such as ammonia and nitrate can have direct toxic effects on stream fauna. I also agree with Mr Canning that other factors such as sedimentation, water clarity, temperature, dissolved oxygen regimes and hydrology are also significant factors that affect the composition of in-stream biotic communities. As noted by Dr Burrell (who has prepared evidence on behalf of Te Runanga o Ngai Tahu), recent studies of Canterbury streams have indicated that, at best, only weak direct relationships were found between nutrient concentrations and aquatic community composition, while other factors such as sedimentation and habitat quality were more direct drivers in the macroinvertebrate community composition (Burdon et al. 2013, Moore and Harding 2014,).

4.3 I have analysed Environment Canterbury's QMCI data collected from 2001 to 2012, and compared values to DIN and DRP concentration for the 6 months preceding the date of macroinvertebrate collection for the Spring-fed Plains streams. Figure 1 illustrates that there is a lack of a clear direct relationship between nutrient concentrations and QMCI values. Furthermore, the data shows that for at least some sampling occasions, the QMCI value of 5 or better was achieved with DRP concentrations in the range of 0.007 to 0.055 mg/L and with DIN concentrations in the range of 4.4 to 7.3 mg/L. Unfortunately there was not QMCI and nutrient data for the other river types in Variation 2 that enabled similar analyses.

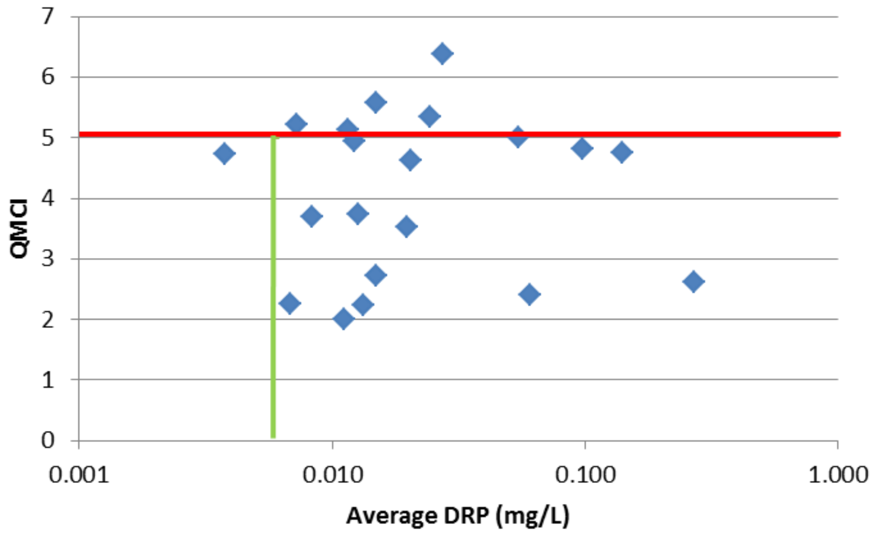
4.4 The DIN values proposed by Mr Canning in particular are very low, and indicate a range that might have occurred in pristine conditions, or at least prior to extensive agricultural development of the Hinds/Hekeao Plains area. I do not consider recommending nitrate concentrations for near pristine type conditions is particularly helpful for the current and realistic future setting for the Hinds/Hekeao Plains areas. In order to achieve DIN concentrations in the range indicated by Mr Canning, this would require a total catchment N load for the Lower Hinds/Hekeao Plains area in the order of 300-400 tonnes N/yr, resulting in average N loss of no more than 3 kgN/ha/yr.[1]

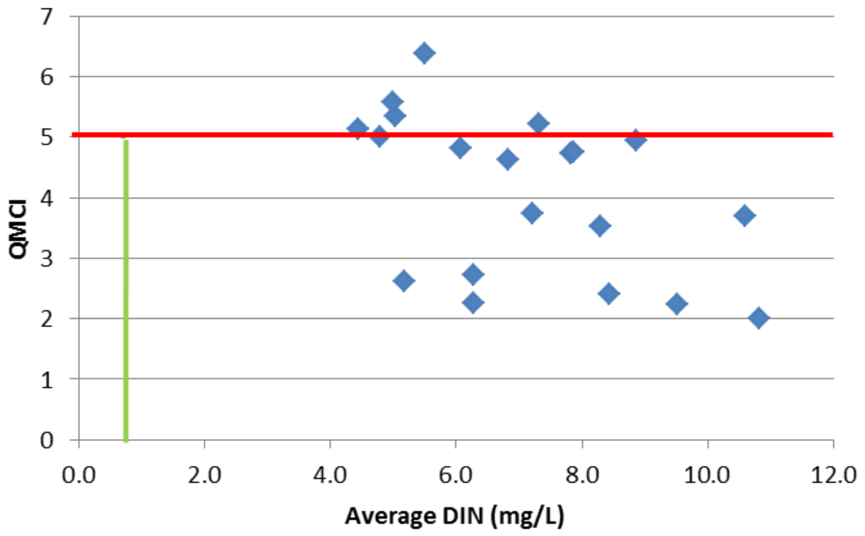
4.5 Mr Canning proposes concentration limits for DRP 0.0004 mg/L for the Hinds River/Hekeao. This low concentration is actually below the level of detection that is achieved by most commercial laboratories, and is certainly below the level of detection by Hills Laboratory, which undertakes analysis for Environment Canterbury (detection limit for DRP = 0.002 mg/L). The value of 0.0004 may be a transcription error. If not, and regardless of the appropriateness of this value in achieving QMCI outcomes, it is not practical nor sensible to set a concentration limit that is well below the threshold at which reliable measurements can be made.

1 The load was estimated using the volume of drainage water modelled by Dr Brown in his primary evidence for the Lower Hinds/Hekeao Plains area. Ie total load = 469 Mm^3/year x 0.7 mg/L DIN = 328 tonnes N. The nitrogen (N) loss per ha was calculated as 328 tonnes N divided by the 127,000 ha = 2.6 kgN/ha/yr.

Figure 1 Relationship between QMCI values and concentrations of DRP and DIN for Spring-fed Plains streams and drains in the Lower Hinds/Hekeao Plains area.

QMCI data are from sampling occasions in 2001, 2006 and 2012 in which 6 months of preceding water quality data were available. Red horizontal line is the QMCI value proposed in Variation 2. Green vertical lines are the DRP/DIN limits proposed by Mr Canning.





4.6 Dr Burrell was of the opinion that DIN concentrations of less than 1.0 mg/L would be needed before benefits to the aquatic ecosystem were achieved through reduced stimulation of nuisance plant growths. I agree with Dr Burrell that concentrations of less than 1.0 mg/L DIN would be needed to exert control over nuisance periphyton growth in the Hinds lowland streams and drains.

4.7 Concentrations this low are unlikely to be achievable in the Hinds/Hekeao Plains area under productive agriculture because of the propensity of the shallow groundwater to accumulate nitrates and the dominating effect of groundwater quality on spring-fed streams. This means that in order to reduce excessive plant growth (both periphyton and macrophytes) other measures need to be employed, such as constraining phosphorus and sediment inputs, stream shading and increased flows. These measures will not only contribute to controlling nuisance growths but also enhance other aspects of stream habitat (e.g., reduce temperatures, greater wetted area, flow variability and improved interstitial spaces). Dr Burrell further recommends that in order to protect ecosystem health, limits on DRP concentrations should be included in Variation 2. He recommended DRP limits for both the upper and lower catchment areas of the Hinds Plains that are based on capping DRP concentrations at current levels (Hill-fed upland annual median DRP limit = 0.02 mg/l, and Hill-fed lower and Spring-fed Plains annual median DRP = 0.008 mg/L). I support this approach as a means of signalling that phosphorus is an important factor affecting aquatic ecosystem health, and any increases risk further deterioration of stream health.

4.8 It is worth noting that for many of the coastal streams and drains, excessive/nuisance macrophyte growths are a significant issue to stream health, aesthetic values and drainage functions. While there are well established relationships between phosphorus concentrations as measured in flowing waters and the risks of nuisance periphyton growths in gravel bed streams, this is not the case for macrophyte growths (Booker and Snelder 2012). Overall, it is the input of phosphorus to a stream, and its availability for plant uptake that is most critical in determining its role in contributing to the risk of nuisance plant growth (both periphyton and macrophytes). I therefore consider that ultimately, the outcomes quantified in Table 13(a) of proposed Variation 2 remain the most important measures of successful management of eutrophication effects.

4.9 To summarise, I consider that the limits proposed in Table 13(j) for nitrate toxicity are appropriate targets over the 20 year timeframe set in proposed Variation 2, and represent a significant improvement in this aspect of water quality. Furthermore, overall improvements in stream health will be achieved through a combination of measures such as an increased extent of stream fencing, implementation of actions identified through farm environment plans to manage run-off and erosion risks to waterways, and increased stream flows.

Shirley Ann Hayward
29 May 2015

References

Booker, D., Snelder, T. 2012: Development of nutrient criteria for managing macrophytes in lowland and spring-fed Canterbury streams. Environment Canterbury report R12/29.

Burdon, F. J. McIntosh, A R., Harding, J. S., 2013 Habitat loss drives threshold response of benthic invertebrate communities to deposited sediment in agricultural streams. Ecol. Appl. 2013 July(5):1036-47

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